65C/194/NP

NEW WORK ITEM PROPOSAL

Proposer	Date of proposal
German NC	June 1998
TC/SC 65C	Secretariat FRANCE
Date of circulation 1998-06-26	Closing date for voting 1998-09-30

A proposal for a new work item within the scope of an existing technical committee or subcommittee shall be submitted to the Central Office. The proposal will be circulated to the P-members of the technical committee or subcommittee for voting, and to the O-members for information. The proposer may be a National Committee of the IEC, the secretariat itself, another technical committee or subcommittee, an organization in liaison, the Committee of Action or one of the advisory committees, or the General Secretary. Guidelines for proposing and justifying a new work item are given in ISO/IEC Directives, Part 1, Annex Q (see extract overleaf). **This form is not to be used for amendments or revisions to existing publications.**

The proposal (to be completed by the proposer)

Title of proposal

High speed extensions for IEC 60625

Standard	Technical Report

Scope (as defined in ISO/IEC Directives, Part 3, 6.2.1)

Defines requirements for an IEC 60625 compatible ATM system to achieve higher transmission speed.

Purpose and justification, including the market relevance and relationship to Safety (Guide 104), EMC (Guide 107), Environmental aspects (Guide 109) and Quality assurance (Guide 102) . (attach a separate page as annex, if necessary)

see Annex 1

Target date	for first CD .Mai 1999........................	for IS .June 2000........................
Estimated number of meetings 5	Frequency of meetings 3 per year	Date and place of first meeting: to be given later
Proposed working methods	x E-mail	ftp

Relevant documents to be considered

IEC 60625-1;1993 and IEC 60625-2;1993

Relationship of project to activities of other international bodies

close Liaison with IEEE/WG HS 488 is recommended

Liaison organizations	**Need for coordination within ISO or IEC**
IEEE, Institute of Electrical and Electronic Engineers, Inc/USA	no

Preparatory work

Check one of the two following boxes

A draft is attached for vote comment X An outline is attached See Annex 2

We nominate a project leader as follows in accordance with ISO/IEC Directives, Part 1, 2.3.4 (name, address, fax and e-mail):
Mr. Dipl. Ing. Jochen Wolle, Rhode & Schwarz GmbH & Co. KG, Gesellschaftsbereich Meßtechnik, Postfach 80, 81614 München, Phone: +89/41 29-30 44, Fax +89/41 29-30 55, eMail: Jochen.wolle@rsd.de

Concerns known patented items (see ISO/IEC Directives, Part 2)	**Name and signature of the proposer**
yes X no If yes, provide full information as an annex	GERMAN NATIONAL COMMITTEE OF THE IEC Secretariat

Comments and recommendations from the TC/SC officers

Comments with respect to the proposal in general, and recommendations thereon		
1) Work allocation Project team	New working group	Existing working group no:
2) Draft suitable for direct submission as CD CDV		
3) General quality of the draft (conformance with ISO/IEC Directives, Part 3) Little redrafting needed	Substantial redrafting needed	no draft (outline only)
4) Relationship with other activities In IEC In other organizations		
Other remarks		

Elements to be clarified when proposing a new work item

Title

Indicate the subject matter of the proposed new standard.

Indicate whether it is intended to prepare a standard, a technical report or an amendment to an existing standard.

Scope

Give a clear indication of the coverage of the proposed new work item and, if necessary for clarity, exclusions.

Indicate whether the subject proposed relates to one or more of the fields of safety, EMC, the environment or quality assurance.

Purpose and justification

Give details based on a critical study of the following elements wherever practicable.

a) The specific aims and reason for the standardization activity, with particular emphasis on the aspects of standardization to be covered, the problems it is expected to solve or the difficulties it is intended to overcome.

b) The main interests that might benefit from or be affected by the activity, such as industry, consumers, trade, governments, distributors.

c) Feasibility of the activity: Are there factors that could hinder the successful establishment or general application of the standard?

d) Timeliness of the standard to be produced: Is the technology reasonably stabilized? If not, how much time is likely to be available before advances in technology may render the proposed standard outdated? Is the proposed standard required as a basis for the future development of the technology in question?

e) Urgency of the activity, considering the needs of the market (industry, consumers, trade, governments etc.) as well as other fields or organizations. Indicate target date and, when a series of standards is proposed, suggest priorities.

f) The benefits to be gained by the implementation of the proposed standard; alternatively, the loss or disadvantage(s) if no standard is established within a reasonable time. Data such as product volume of value of trade should be included and quantified.

g) If the standardization activity is, or is likely to be, the subject of regulations or to require the harmonization of existing regulations, this should be indicated.

If a series of new work items is proposed, the purpose and justification of which is common, a common proposal may be drafted including all elements to be clarified and enumerating the titles and scopes of each individual item.

Relevant documents

List any known relevant documents (such as standards and regulations), regardless of their source. When the proposer considers that an existing well-established document may be acceptable as a standard (with or without amendments), indicate this with appropriate justification and attach a copy to the proposal.

Cooperation and liaison

List relevant organizations or bodies with which cooperation and liaison should exist.

Preparatory work

Indicate the name of the project leader nominated by the proposer.

Annex 1 to New Work item Proposal "High speed extensions for IEC 60625"

Purpose and Justification

Rationale

In the world of Test and Measurement, the IEC 60625-1 (GPIB) standard has proven its reliability over the last two decades. Thousands of instruments are equipped with this widely accepted and popular interface, which satisfactory meets the requirements of major classes of instruments. It is, therefore, certainly to be expected that the IEC 60625 standard will survive another decade.

It cannot be denied, however, that certain applications exist that require a higher data transmission rate than possible within the current IEC 60625-1 specifications. Furthermore, it is understandable that such applications may want to use a well-established interface standard like IEC 60625-1. By creating solutions that meet the requirements of such applications, full compatibility must be maintained with past and future implementations to protect the investments of instrument manufacturers and customers.

Recommended actions

Re-establish the WG3 "Programmable Measuring Apparatus" to undertake the following steps:

- Identify higher speed operations for IEC 60625-1.
- Work out a proposal that maintains full compatibility with the current and previous versions of the IEC 60625-1 standard.

Annex 2 to New Work item Proposal "High speed extensions for IEC 60625"

Outline

This paper proposes a solution for applications that require a faster data exchange than possible with the current IEC 60625-1 specifications. The proposal does not modify any of the existing protocols nor does it require the implementation of additional circuitry. Instead, it explicitly states the conditions that allow for a higher speed operation. These conditions are a further limitation of the conditions that are stated in IEC 60625-1, Clauses 24 and 31.3 on high-speed operation.

Calculations show that:
- a limited cable length

and - adding resistive loads (up to the maximum of 15)

allow to reduce the data settling time T_1, which in its turn, causes an increase of the transmission speed.

Theoretical background

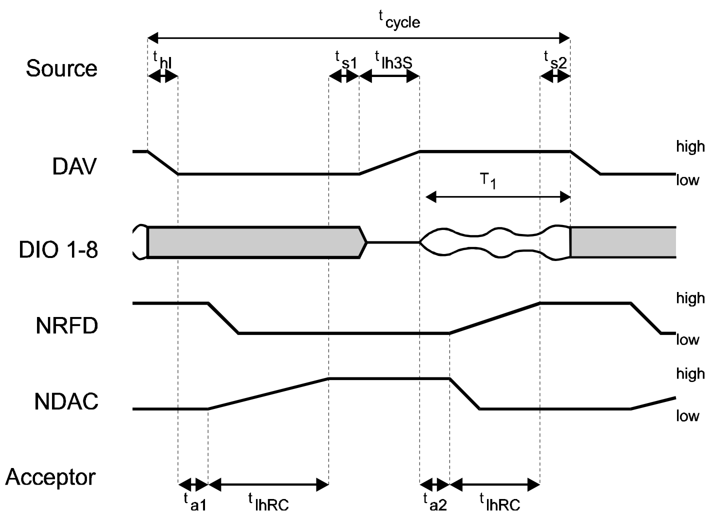


Figure 1. Three wire handshake

This section provides a theoretical basis for an increase of the data transfer rate beyond the maximum level being established by the current standard.

The following conditions, as required by the IEC 60625-1 standard for high-speed operations, are assumed to be satisfied:

- Except for the NDAC, NRFD and SRQ lines, which use 48 mA open collector drivers, all other signal lines use 48 mA three state drivers.
- Maximum cabling is 15 meters
- Device capacitance is less than 50 pF
- Cable capacitance is less than 150 pF/meter

The maximum possible data transfer rate depends on the timing of the bus signals as shown by Figure 1.

DAV	Data Valid line
DIO1 to 8	The 8 Data I/O lines DIO1 to DIO8.
NRFD	Not Ready For Data line
NDAC	Not Data Accepted line
t_{hl}	High → Low transition time on line driven by an open collector or three state driver
t_{lhRC}	Low → High transition on an open collector driven line
t_{lh3S}	Low → High transition on line driven by a three state driver
t_{a1} and t_{a2}	Reaction times of the acceptor functions
t_{s1} and t_{s2}	Reaction times of the source functions
T_1	Settling time for the data signals
t_{cycle}	Total cycle time for the transfer of a data byte

The total cycle time is calculated from the expression:

$$t_{cycle} = t_{hl} + t_{a1} + t_{lhRC} + t_{s1} + t_{lh3S} + MAX\left[t_{a2} + t_{lhRC} + t_{s2}; T_1\right]$$

With relation to t_{hl}, t_{lhRC} and t_{lh3S}, the reaction times t_a and t_s can be ignored; therefore:

$$t_{cycle} \approx t_{hl} + t_{lhRC} + t_{lh3S} + MAX\left[t_{lhRC}; T_1\right] \qquad .....(1)$$

Data settling time T_1

The data settling time T_1 is the time the source will wait before it asserts the DAV = True message (DAV line 'Low'). The value of T_1 is specified by the GPIB standard and is a fixed value which is based on worst case settling time conditions. The data signal lines are driven by three state drivers; therefore, the minimum required settling time value T_1 is determined by the maximum values for t_{hl} and t_{lh3S}. Thus, the 350 nsec value for T_1 , specified by the GPIB standard, is based on the largest expected values for t_{hl} and t_{lh3S}. These values, however, considerably decrease when:

- cable length is much less than 15 meters
- resistive loads are added up to a level of maximum of 15 loads per system

As a result of lower t_{hl} and t_{lh3S} values, it would be allowed to decrease the needed minimum data settling time T_1 the currently specified level of 350 ns, as will be clarified later on.

Calculation of the transition times

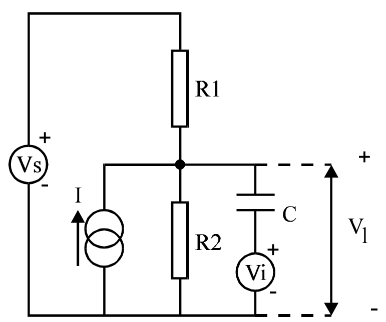
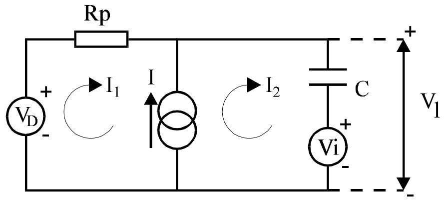


Figure 2. Device driver circuitry

V_S	Supply voltage; V_S = 5V
R1 and R2	Terminator resistors;
	R_1 = 3 kΩ; R_2= 6.2 kΩ;
C	Total device and cable capacitance
	C_{dev} = 50 pF; C_{cable} = 150 pF/m
V_i	Initial voltage over the capacitance C;
	initial line voltage.
I	Drive current (source/sink)

The circuit of Figure 2 can be simplified to the calculation model as is shown in Figure 3.



$$R_p = \frac{R_1 \cdot R_2}{R_1 + R_2} \approx 2k\Omega$$

$$V_D = \frac{R_2}{R_1 + R_2} V_S \approx 3.4V$$

Figure 3. Device driver calculation model

From Figure 3, it can be calculated:

$$\frac{V_D}{p} - I_1(p).R_p - V_l(p) = 0 \quad \Rightarrow \quad I_1(p) = \frac{1}{R_p}\left\{\frac{V_D}{p} - V_l(p)\right\} \quad .....(2)$$

$$\frac{V_i}{p} + \frac{I_2(p)}{pC} = V_l(p) \quad \Rightarrow \quad I_2(p) = pC\left\{V_l(p) - \frac{V_i}{p}\right\} \quad .....(3)$$

$$\frac{I}{p} = I_2(p) - I_1(p) \quad .....(4)$$

Substituting (2) and (3) into equation (4):

$$pC\left\{V_l(p) - \frac{V_i}{p}\right\} - \frac{1}{R_p}\left\{\frac{V_D}{p} - V_l(p)\right\} = \frac{I}{p} \quad \Rightarrow \quad V_l(p) = \frac{I \cdot R_p + V_D + ptV_i}{p(1 + pt)}$$ with $t = R_p.C$

or:

$$V_l(t) = (I \cdot R_p + V_D) - (I \cdot R_p + V_D - V_i)e^{-\frac{t}{t}}. \quad ....(5)$$

The time t_0, needed to for the voltage $V_l(t_0)$ to reach the level V_0, can be calculated from the equation:

$$V_l(t_0) = V_0 \quad ....(6)$$

Substituting (6) into equation (5) results in:

$$t_0 = -t \ln\left\{\frac{I \cdot R_p + V_D - V_0}{I \cdot R_p + V_D - V_i}\right\}$$ with $t = R_p.C$ .....(7)

Table 1 lists the initial voltage and current values to be used for the calculation of the signal transition times on the bus.

	Open collector Three state	**Open collector**	**Three state**	**Description**
	t_{hl}	t_{lhRC}	t_{lh3S}	
I	-48 mA	0 mA	5.2 mA	Device sink/source current
V_i	3.4 V	0.4 V	0.4 V	Initial voltage level on the line
V_0	0.8 V	2.0 V	2.0 V	Voltage level for 'Low' and 'High' level detection

Table 1.

Additional resistive loads

In order to improve the speed performance, the IEC 60625-1 standard recommends to use additional resistive loads. This means that additional to the device loads, resistive loads may be added up to a maximum of 15 loads.

Assume a system, with n connected devices (1 ≤ n ≤ 15) and 1 meter of cabling between each device. Furthermore, (15-n) additional resistive loads are added.

This means that: $R_P = \frac{2 \cdot 10^3}{n + (15 - n)} = 133\Omega$ and $C = n \cdot 50 \cdot 10^{-12} + (n-1) \cdot 150 \cdot 10^{-12} = 50 \cdot (4n-3)\ pF$

By substituting these values into equation 7, the transition time t0 is determined by the following equation:

$$t_0 = -133 \cdot 50 \cdot (4n-3) \cdot 10^{-12} \ln\left\{\frac{-133 \cdot I + V_D - V_0}{-133 \cdot I + V_D - V_i}\right\} = 6{,}65 \cdot \left(4n-3) \cdot 10^{-9}\right) \cdot \ln\left\{\frac{133 \cdot I + V_D - V_0}{133 \cdot I + V_D - V_i}\right\}$$

Using the initial values of Table 1, the following figures can be calculated:

$$t_{hl} = 6{,}65 \cdot (4n-3) \cdot 10^{-9} \cdot \ln\left\{\frac{133 \cdot 48 \cdot 10^{-3} + 3{,}4 - 0{,}8}{133 \cdot 48 \cdot 10^{-3} + 3{,}4 - 3{,}4}\right\} = 6{,}65 \cdot (4n-3) \cdot 10^{-9} \cdot \ln\left\{\frac{-3{,}784}{-6{,}384}\right\} = 3{,}48(4n-3) \cdot 10^{-9}$$

$$t_{lhRC} = 6{,}65 \cdot (4n-3) \cdot 10^{-9} \cdot \ln\left\{\frac{3{,}4 - 2{,}0}{3{,}4 - 0{,}4}\right\} = 6{,}65 \cdot (4n-3) \cdot 10^{-9} \cdot \ln\left\{\frac{1{,}4}{3}\right\} = 5{,}07 \cdot (4n-3) \cdot 10^{-9}$$

$$t_{lh3S} = 6{,}65 \cdot (4n-3) \cdot 10^{-9} \cdot \ln\left\{\frac{133 \cdot 5{,}2 \cdot 10^{-3} + 3{,}4 - 2}{133 \cdot 5{,}2 \cdot 10^{-3} + 3{,}4 - 0{,}4}\right\} = 6{,}65 \cdot (4n-3) \cdot 10^{-9} \cdot \ln\left\{\frac{-2{,}09}{-3{,}69}\right\} = 3{,}78 \cdot (4n-3) \cdot 10^{-9}$$

The most optimal value for T1 is determined by tlh3S. Using this value for T1, the cycle time tcycle can be calculated using the next expressions:

$$t_{cycle} = (3{,}48 + 5{,}07 + 2 \cdot 3{,}78) \cdot (4n-3) \cdot 10^{-9} = 16{,}11 \cdot (4n-3)\ n\sec$$

The transmission frequency $f = \frac{1}{t_{cycle}} \approx \frac{62}{(4n-3)} MBytes/\sec$

NOTES:

1. Devices with a settable T_1, device capacitance of 50 pF, or having multiple resistive loads shall be so marked as acceptable variants.
2. Control of T_1 may be done remotely or locally. The number of resistive powered loads in a device may also be controlled remotely or locally.
3. Use of data byte buffer store within the device may be advantageous.

Conclusions

- Data transfer rates up to 5 - 10 Mbytes/sec are possible.
- Requires no additional functions.
- Capabilities of existing IEC 60625-1 standard are used
- Full compatibility with existing and previous versions of the IEC60625-1 standard is guaranteed.
- No modification, but an extension of the IEC 60625-1 standard.